National Snow Analysis (NSA)
National Operational Hydrologic Remote Sensing Center

Part 1 - Mission Connection

a.   <u>Product Description</u> - The National Operational Hydrologic Remote Sensing Center (NOHRSC) is a branch in the Office of Climate, Water, and Weather Services in the National Weather Services (NWS) and is collocated with the NWS North Central River Forecast Center and the Weather Forecast Office in Chanhassen, Minnesota. The NOHRSC produces a daily National Snow Analysis (NSA) and distributes a variety of snow summaries and data sets derived from both observed and modeled hydrometeorological data. The NOHRSC NSA provides daily, comprehensive snow information for the coterminous U.S. The NSA is based on modeled snowpack characteristics that are updated using all operationally available ground-based, airborne, and satellite observations of snow water equivalent, snow depth, and snow cover. The NOHRSC energy-and-mass-balance snow model is a multi-layer, physically based snow model operated at 1 km² spatial resolution and hourly temporal resolution for the nation. Snow observations that are used to update the snow model include, but are not limited to, snow data from the NOHRSC's Airborne Snow Survey Program, NWS and FAA field offices, NWS Cooperative Observers, the NRCS SNOTEL and snow course networks, the California Department of Water Resources snow pillow networks, and areal extent of snow cover observations derived from NOAA's GOES and POES satellites. The NSA summaries include information about snow water equivalent, snow depth, snow temperature, snowmelt, surface sublimation and condensation, sublimation from blowing snow, snow surface energy exchanges, precipitation, and weather.   Through the NSA, the NOHRSC provides a variety of snow cover summaries and data sets to NWS field offices and other federal, state, and local agencies and to the private sector for use in a variety of applications including operational and research hydrologic modeling used in snowmelt flood forecasting and water supply forecasting. Principle NOHRSC NSA summaries are described in more detail in Part 2 of this document and include:

1. National and regional snow discussions (text),

2. Interactive snow information with map and query functionality and user-selectable physical elements, map overlays, geographic regions, and zoom levels (graphic),

3. Station time-series plots of modeled forcing data and snow model state simulations along with observed snow water equivalent, snow depth, and other hydrometeorological variables (graphic), and

4. Alphanumeric summaries, on a basin-by-basin basis, of the mean, maximum, minimum, and standard deviation of snow water equivalent, snow depth, and areal extent of snow cover (text).

b.   <u>Purpose</u> - The purpose of the NOHRSC NSA is to provide NWS and non-NWS end-users

with the "best estimate" of snow water equivalent, snow depth, and other snowpack characteristics derived from *all* available modeled and observed hydrometeorological data sets. A principle feature of the NSA provides daily national and regional snow discussions, in text format, that review the most recent snow storm systems that have impacted the coterminous U.S. The snow discussions are intended not only to provide an overview of the salient, synoptic, snow system meteorology, but also to provide an enlightened discussion on the performance of the NOHRSC snow model as it simulates snow accumulation and ablation across the country.

c.   Audience - Accurate, reliable, near-real time estimates of snow water equivalent, in multiple formats, are critical to a variety of end-users interested in operational and research hydrologic modeling. Because the NOHRSC snow summaries are generated for the coterminous U.S. at a 1 km^2 spatial resolution and at a 1 hour temporal resolution, they are of particular interest to hydrologists who support distributed hydrologic modeling not only in the NWS, but also in other federal, state, and local agencies as well as in the private sector. Additionally, the NSA provides, for the first time, a broad selection of snow summaries and data sets in multiple, quantitative formats to non-hydrologic users including those with interests in: meteorology, agriculture, recreation, environmental monitoring, water quality, etc.

d.   Presentation Format -   The NOHRSC NSA graphical format includes static graphics as well as a web-based products that provides the capability for the end-user to select interactively the geographic region of interest, the physical element of interest, the period-of-record of interest, and to generate summaries in multiple formats. Summaries formats include text (snow discussions), alphanumeric (basin-by-basin analysis), graphic (maps and x-y plots of snow characteristics), gridded (physical elements), and PostScript (hardcopy map printout).

e.   Feedback Method - We are constantly seeking to improve the NOHRSC NSA product based on user feedback. We are actively soliciting end-users to complete a short survey questionnaire evaluating the NSA product and its associated summaries on the Review the NOHRSC National Snow Analysis page. Additionally, informal comments are always welcome on the Please Send Us Comments page. The feedback period is October 1, through July, 2004. All comments can also be addressed to:

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Part 2 - Technical Description

Principle features of the NOHRSC NSA product include:

1. <u>National and regional snow summary discussions (text)</u>.

> The NOHRSC National Daily Snow Summary and Regional Snow Discussions provide a daily overview of snow conditions for the coterminous U.S. as well as for specific regions of the U.S. The snow discussions are subjective, text descriptions of daily snow accumulation based on snow observations and modeled snowpack characteristics. They review both the meteorological observations of snowfall and snow on the ground as well as the snowfall and snow accumulation simulated by the NOHRSC snow model. Regions of the greatest, or most interesting, snow precipitation are highlighted in the discussions. The snow discussions also provide an explanation of the variance between the NOHRSC snow model state variables and observed snow conditions. The discussions review the regions across the country where observed snow data have been assimilated into the snow model state variables. Unique snow data observations such as airborne snow water equivalent measurements are reviewed in the discussions during the course of operational airborne snow survey missions. Image maps of snow characteristics and other graphics summaries are hyper-linked in the discussions to highlight specific points of interest. Daily text files are also created for each region reporting station snowfall, snow depth, and snow water equivalent. The snow discussions are prepared daily by NOHRSC personnel.

2. <u>Interactive snow maps (graphic)</u>.

> The Interactive Snow Information summary from the NSA product allows the end-user to select the geographic region of interest, the period-of-record of interest, and the physical element of interest. The summary has pan, zoom, and query functionality. End-users can query on 28 physical elements including: snow water equivalent, snow depth, snowpack temperature, snow precipitation, non-snow precipitation, surface air temperature, solar radiation, relative humidity, daily change in snow water equivalent, daily change in snow depth, daily snowmelt, daily blowing snow sublimation, daily surface sublimation/condensation, daily average snowpack temperature, daily snow precipitation, and satellite snow cover. The map of the selected physical element can be overlaid with 17 different GIS vector data sets including: rivers, hydrologic basins, RFC boundaries, highways, cities, meteorological stations, airborne flight lines, etc. The NOHRSC Interactive Snow Information summary gives the end-user the flexibility to produce tailored graphic summaries suited to individual needs and requirements. The graphic maps from the Interactive Snow Information summary can be queried in either metric or English units.   PostScript format for hardcopy output is supported. The summary can be configured for Internet Explorer or Netscape.

3. <u>Station time-series plots (graphic)</u>.

> The NOHRSC station time-series plot consists of a series of x-y graphic plots using data

from a selected reporting station for a selected period-of-record. The plots include line graphs of NOHRSC snow model output and point indicators for a variety of observed hydrometeorological variables. Meteorological data from over 18000 reporting stations throughout the coterminous U.S. are available for comparison to the NOHRSC snow model output.   The station time-series plots include graphs of modeled and/or observed snow water equivalent, snow depth, snow cover, snowmelt, snow surface temperature, mean snowpack temperature, air temperature, snow and non-snow precipitation, sublimation/condensation, various weather forcings, and snow surface energy exchanges. The station time-series plots provide the end-user with very specific modeled and observed data from over 18000 reporting stations across the country.

4. Alphanumeric snow summaries (text).

Alphanumeric summaries for selected NSA physical elements are available on a hydrologic basin-by-basin basis. Alphanumeric summaries are available for snow water equivalent, snow depth, and areal extent of snow cover. The summaries include the basin id, date, minimum and maximum elevation in the basin, basin name (if available), and the mean, standard deviation, minimum, and maximum values for the basin for the selected physical element. The end-user can select the area of interest, such as basins by RFC, physical element, the date, and the units (English or metric) for the report. A key to the report nomenclature is included in the summary.

Snow summaries from the NOHRSC NSA are available daily (excluding weekends and holidays).

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